# Some Applications of Trigonometry

CASE STUDY / PASSAGE BASED QUESTIONS

1

Visit to Temple

There are two temples on each bank of a river. One temple is 50 m high. A man, who is standing on the top of 50 m high temple, observed from the top that angle of depression of the top and foot of other temple are 30° and 60° respectively. (Take $\sqrt{3} = 1.73$)

Based on the above information, answer the following questions.

(i) Measure of $\angle ADF$ is equal to

(a) 45°   (b) 60°   (c) 30°   (d) 90°

(ii) Measure of $\angle ACB$ is equal to

(a) 45°   (b) 60°   (c) 30°   (d) 90°

(iii) Width of the river is

(a) 28.90 m   (b) 26.75 m

(c) 25 m   (d) 27 m

(iv) Height of the other temple is

(a) 32.5 m   (b) 35 m

(c) 33.33 m   (d) 40 m

(v) Angle of depression is always

(a) reflex angle   (b) straight

(c) an obtuse angle   (d) an acute angle
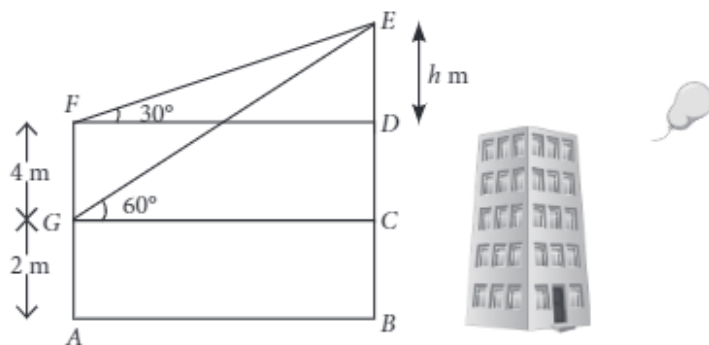
Observation of a Balloon

There are two windows in a house. First window is at the height of 2 m above the ground and other window is 4 m vertically above the lower window. Ankit and Radha are sitting inside the two windows at points G and F respectively. At an instant, the angles of elevation of a balloon from these windows are observed to be 60° and 30° as shown below.

Based on the above information, answer the following questions.
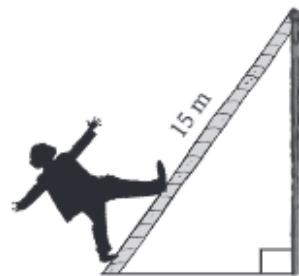
(i) Who is more closer to the balloon?

    (a) Ankit   (b) Radha

    (c) Both are at equal distance   (d) Can't be determined

(ii) Value of DF is equal to

    (a) $\dfrac{h}{\sqrt{3}}$ m   (b) $h\sqrt{3}$ m   (c) $\dfrac{h}{2}$ m   (d) $2h$ m

(iii) Value of h is

    (a) 2   (b) 3   (c) 4   (d) 5

(iv) Height of the balloon from the ground is

    (a) 4 m   (b) 6 m   (c) 8 m   (d) 10 m

(v) If the balloon is moving towards the building, then both angle of elevation will

    (a) remain same   (b) increases   (c) decreases   (d) can't be determined

Stunt by Circus Artist

A circus artist is climbing through a 15 m long rope which is highly stretched and tied from the top of a vertical pole to the ground as shown below.
Based on the above information, answer the following questions.

(i) Find the height of the pole, if angle made by rope to the ground level is 45°.

    (a) 15 m   (b) $15\sqrt{2}$ m

    (c) $\dfrac{15}{\sqrt{3}}$ m   (d) $\dfrac{15}{\sqrt{2}}$ m

(ii) If the angle made by the rope to the ground level is 45°, then find the distance between artist and pole at ground level.

(a) $\dfrac{15}{\sqrt{2}}$ m   (b) $15\sqrt{2}$ m   (c) 15 m   (d) $15\sqrt{3}$ m

(iii) Find the height of the pole if the angle made by the rope to the ground level is 30°.

(a) 2.5 m   (b) 5 m   (c) 7.5 m   (d) 10 m

(iv) If the angle made by the rope to the ground level is 30° and 3 m rope is broken, then find the height of the pole.

(a) 2 m   (b) 4 m   (c) 5 m   (d) 6 m

(v) Which mathematical concept is used here?

(a) Similar Triangles   (b) Pythagoras Theorem
(c) Application of Trigonometry   (d) None of these

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Fire Incident

There is fire incident in the house. The house door is locked so, the fireman is trying to enter the house from the window. He places the ladder against the wall such that its top reaches the window as shown in the figure.

Based on the above information, answer the following questions.

(i) If window is 6 m above the ground and angle made by the foot of ladder to the ground is 30°, then length of the ladder is

(a) 8 m   (b) 10 m   (c) 12 m   (d) 14 m

(ii) If fireman place the ladder 5 m away from the wall and angle of elevation is observed to be 30°, then length of the ladder is

(a) 5 m   (b) $\dfrac{10}{\sqrt{3}}$ m   (c) $\dfrac{15}{\sqrt{2}}$ m   (d) 20 m
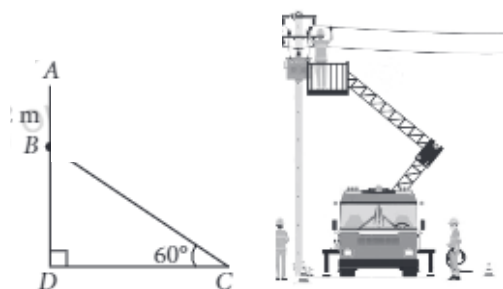
(iii) If fireman places the ladder 2.5 m away from the wall and angle of elevation is observed to be 60°, then find the height of the window. (Take $\sqrt{3} = 1.73$)

(a) 4.325 m   (b) 5.5 m   (c) 6.3 m   (d) 2.5 m

(iv) If the height of the window is 8 m above the ground and angle of elevation is observed to be 45°, then horizontal distance between the foot of ladder and wall is

(a) 2 m   (b) 4 m   (c) 6 m   (d) 8 m

(v) If the fireman gets a 9 m long ladder and window is at 6 m height, then how far should the ladder be placed?

(a) 5 m   (b) $3\sqrt{5}$ m   (c) 3 m   (d) 4 m

Repairing of Electric Fault

An electrician has to repair an electric fault on the pole of height of 8 m. He needs to reach a point 2 m below the top of the pole to undertake the repair work.
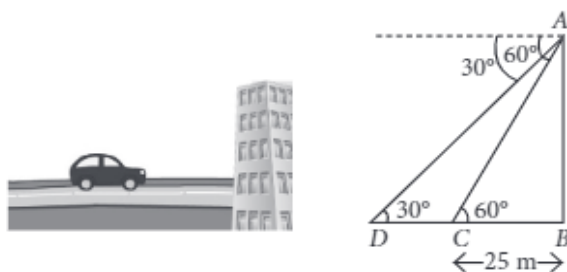
Based on the above information, answer the following questions.

(i) Length of BD is

    (a) 10 m   (b) 6 m   (c) 4 m   (d) 4 m

(ii) What should be the length of ladder, so that it makes an angle of 60° with the ground?

    (a) $4\sqrt{3}$ m   (b) $2\sqrt{3}$ m   (c) $3\sqrt{3}$ m   (d) $5\sqrt{3}$ m

(iii) The distance between the foot of ladder and pole is

    (a) $6\sqrt{3}$ m   (b) $4\sqrt{3}$ m   (c) $3\sqrt{3}$ m   (d) $2\sqrt{3}$ m

(iv) What will be the measure of $\angle BCD$ when BD and CD are equal?

    (a) 30°   (b) 45°   (c) 60°   (d) 75°

(v) Find the measure of $\angle DBC$.

    (a) 15°   (b) 60°   (c) 30°   (d) 45°

Application of Trigonometry for Moving Car

Rohit is standing at the top of the building observes a car at an angle of 30°, which is approaching the foot of the building with a uniform speed. 6 seconds later, angle of depression of car formed to be 60°, whose distance at that instant from the building is 25 m.

Based on the above information, answer the following questions.
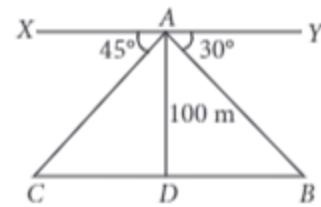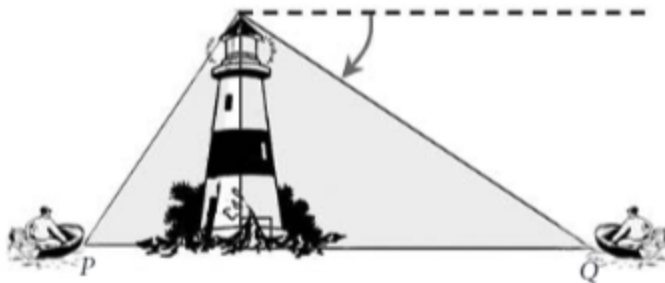
(i) Height of the building is

    (a) $25\sqrt{2}$ m   (b) 50 m   (c) $25\sqrt{3}$ m   (d) 25 m

(ii) Distance between two positions of the car is

(a) 40 m   (b) 50 m   (c) 60 m   (d) 75 m

(iii) Total time taken by the car to reach the foot of the building from starting point is

(a) 4 sec.   (b) 3 sec.   (c) 6 sec.   (d) 9 sec.

(iv) The distance of the observer from the car when it makes an angle of 60° is

(a) 25 m   (b) 45 m   (c) 50 m   (d) 75 m

(v) The angle of elevation increases

(a) when point of observation moves towards the object

(b) when point of observation moves away from the object

(c) when object moves away from the observer

(d) None of these

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Light House

A boy is standing on the top of light house. He observed that boat P and boat Q are approaching to light house from opposite directions. He finds that angle of depression of boat P is 45° and angle of depression of boat Q is 30°. He also knows that height of the light house is 100 m.

Based on the above information, answer the following questions.

(i) Measure of $\angle ACD$ is equal to

(a) 30°   (b) 45°   (c) 60°   (d) 90°

(ii) If $\angle YAB = 30°$, then $\angle ABD$ is also 30°, Why?

(a) vertically opposite angles   (b) alternate interior angles

(c) alternate exterior angles   (d) corresponding angles

(iii) Length of CD is equal to

(a) 90 m   (b) 60 m   (c) 100 m   (d) 80 m

(iv) Length of BD is equal to

(a) 50 m   (b) 100 m

(c) $100\sqrt{2}$ m   (d) $100\sqrt{3}$ m

(v) Length of AC is equal to

(a) $100\sqrt{2}$ m   (b) $100\sqrt{3}$ m

(c) 50 m   (d) 100 m

Visit to Exhibition

In an exhibition, a statue stands on the top of a pedestal. From the point on ground where a girl is clicking the photograph of the statue the angle of elevation of the top of the statue is 60° and from the same point, the angle of elevation of the top of pedestal is 45°.
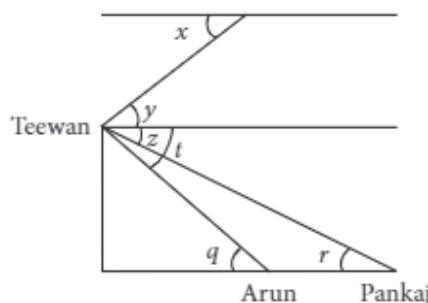
Based on the above information, answer the following questions.

(i) If the height of the pedestal is 20 m, then the distance between girl and the foot of the pedestal is
   (a) 20 m   (b) 40 m   (c) 60 m   (d) 80 m

(ii) If the height of the pedestal is 20 m, then the height of the statue is
   (a) $20\sqrt{3}$ m   (b) $20(\sqrt{3}-1)$ m   (c) $20(\sqrt{3}+1)$ m   (d) $10(\sqrt{3}-1)$ m

(iii) If the height of the statue is 1.6 m, then height of the pedestal is
   (a) $0.8(\sqrt{3}-1)$ m   (b) $1.6(\sqrt{3}+1)$ m   (c) $0.8(\sqrt{3})$ m   (d) $0.8(\sqrt{3}+1)$ m

(iv) If the total height of the statue and pedestal is 39 m, then find the length of AC.
   (a) 13 m   (b) $12\sqrt{3}$ m   (c) $13\sqrt{3}$ m   (d) $15\sqrt{3}$ m

(v) If the height of the pedestal is 35 m, then length of AD is
   (a) $35\sqrt{2}$ m   (b) $40\sqrt{2}$ m   (c) $35(\sqrt{2}+1)$ m   (d) $35(\sqrt{2}-1)$ m

Diwali Celebration

Teewan, Arun and Pankaj were celebrating the festival of Diwali in open ground with firecrackers. There is a pedestal in the ground. All of sudden Teewan stands on pedestal and release sky lantern from the top of pedestal.

Based on the above information answer the following questions. (Take $\sqrt{3}=1.73$)
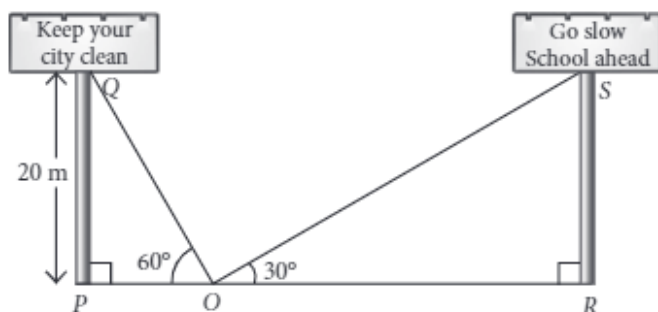
(i) Which one is a pair of angle of depression?
   (a) $(\angle x, \angle y)$ (b) $(\angle y, \angle z)$ (c) $(\angle z, \angle t)$ (d) $(\angle r, \angle q)$

(ii) If the position of Pankaj is 25 m away from the base of pedestal and $\angle r = 30°$, then find the height of pedestal.

(a) 14.45 m (b) 15.5 m (c) 16.36 m (d) 17.36 m

(iii) If the height of pedestal is 30 m, $\angle t = 45°$ and $\angle z = 30°$, then the horizontal distance between Arun and Pankaj is

(a) 24.5 m (b) 19.5 m (c) 20 m (d) 21.9 m

(iv) If the vertical height of sky lantern from the top of pedestal is 12 m and $\angle y = 30°$, then distance between Teewan and sky lantern is

(a) 20 m (b) 16.97 m (c) 24 m (d) 19.86 m

(v) If $\angle q = 60°$ and position of Arun is 15 m away from the base of pedestal, then find the height of pedestal.

(a) 16.25 m (b) 25 m (c) 25.95 m (d) 26 m

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Hoardings on the Road

Two hoardings are put on two poles of equal heights standing on either side of the road. From a point between them on the road the angle of elevation of the top of poles are 60° and 30° respectively. Height of the each pole is 20 m

Based on the above information, answer the following questions. (Take $\sqrt{3} = 1.73$).

(i) Find the length of PO.

(a) 20 m (b) $20\sqrt{3}$ m (c) $\dfrac{20}{\sqrt{3}}$ m (d) None of these

(ii) Find the length of RO.

(a) 20 m (b) $20\sqrt{3}$ m (c) $\dfrac{20}{\sqrt{3}}$ m (d) None of these

(iii) The width of the road is

(a) 31.23 m (b) 35.68 m (c) 39.73 m (d) 46.24 m

(iv) If the angle of elevation made by pole PQ is 45°, then the length of PO =

(a) 20 m (b) $20\sqrt{3}$ m (c) $\dfrac{20}{\sqrt{3}}$ m (d) None of these

(v) Angle formed by the line of sight with the horizontal when the point being viewed is above the horizontal level is known as

(a) angle of depression (b) angle of elevation (c) right Angle (d) reflex angle
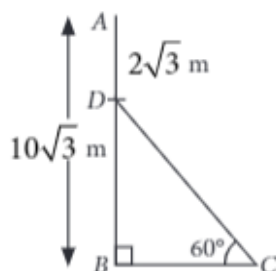
Applications of Trigonometry - Broken Tree

Suppose a straight vertical tree is broken at some point due to storm and the broken part is inclined at a certain distant from the foot of the tree.
Based on the above information, answer the following questions.
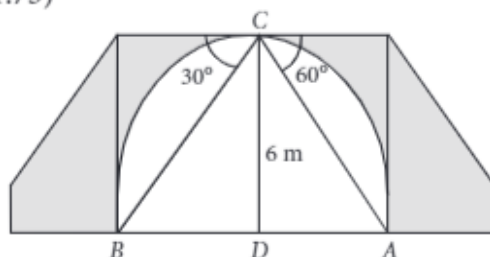
(i) If the top of upper part of broken tree touches ground at a distance of 30 m (from the foot of the tree) and makes an angle of inclination 30°, then the height of remaining part of the tree is

(a) $\sqrt{3}$ m
(b) $30\sqrt{3}$ m
(c) $\dfrac{30}{\sqrt{3}}$ m
(d) 30 m

(ii) If the top of broken part of a tree touches the ground at a point whose distance from foot of the tree is equal to height of remaining part, then its angle of inclination is

(a) 30°
(b) 60°
(c) 45°
(d) None of these

(iii) The angle of elevation are always

(a) obtuse angle
(b) acute angle
(c) right angle
(d) reflex angle

(iv) If $AB = 10\sqrt{3}$ m, $AD = 2\sqrt{3}$ m, then $CD =$

(a) 9 m
(b) 11 m
(c) 14 m
(d) 16 m

(v) If the height of a tree is 6 m, which is broken by wind in such a way that its top touches the ground and makes an angles 30° with the ground. At what height from the bottom of the tree is broken by the wind?

(a) 2 m
(b) 4 m
(c) 8 m
(d) 10 m

Trigonometry in Bridge Design

One day while sitting on the bridge across a river Arun observes the angles of depression of the banks on opposite sides of the river are 30° and 60° respectively as shown in the figure. (Take $\sqrt{3} = 1.73$)

Based on the above information, answer the following questions.

(i) If the bridge is at a height of 6 m, then $AD =$

(a) 6 m   (b) $\dfrac{\sqrt{3}}{6}$ m   (c) $6\sqrt{3}$ m   (d) $\dfrac{6}{\sqrt{3}}$ m

(ii) $BD =$

(a) 6 m   (b) $6\sqrt{3}$ m   (c) $\sqrt{3}$ m   (d) $10\sqrt{3}$ m

(iii) Width of the river is

(a) 10.85 m   (b) 13.87 m   (c) 15.85 m   (d) 19.85 m

(iv) The angles of elevation and depression are always

(a) acute angles   (b) obtuse angles   (c) right angles   (d) straight angles

**(v)** If $BD = 21$ m, then height of the bridge is
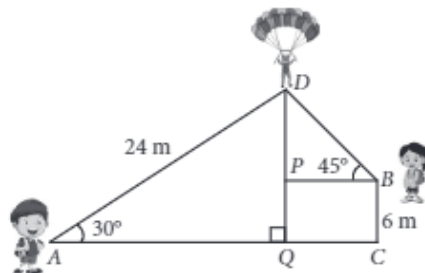
(a) 7 m   (b) 21 m   (c) $7\sqrt{3}$ m   (d) $\dfrac{7}{\sqrt{3}}$ m

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Hot Air Balloon

Karan and his sister Riddhima visited at their uncle's place-Bir, Himachal Pradesh. During day time Karan, who is standing on the ground spots a paraglider at a distance of 24 m from him at an elevation of 30°. His sister Riddhima is also standing on the roof of a 6 m high building, observes the elevation of the same paraglider as 45°. Karan and Riddhima are on the opposite sides of the paraglider.

Based on the above information, answer the following questions.

(i) The distance of paraglider from the ground is

(a) 10 m   (b) 12 m   (c) 18 m   (d) 22 m
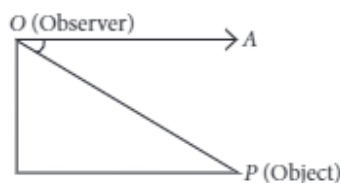
(ii) The value of PD is

(a) 6 m   (b) 7 m   (c) 8 m   (d) 9 m

(iii) The distance between the paraglider and the Riddhima is

(a) $\sqrt{2}$ m   (b) 6 m   (c) $6\sqrt{2}$ m   (d) $\dfrac{6}{\sqrt{2}}$ m

(iv) In the given figure, $\angle AOP$ is

(a) Reflex angle   (b) Angle of elevation

(c) Straight angle   (d) Angle of depression

(v) If A and B are two objects and the eye of an observer is at point O, then the line of sight will be

(a) OA (b) OB

(c) Both (a) and (b)   (d) None of these

Flying Pigeon

A boy 4 m tall spots a pigeon sitting on the top of a pole of height 54 m from the ground. The angle of elevation of the pigeon from the eyes of boy at any instant is 60°. The pigeon flies away horizontally in such a way that it remained at a constant height from the ground. After 8 seconds, the angle of elevation of the pigeon from the same point is 45°

Based on the above information, answer the following questions. (Take $\sqrt{3}=1.73$)

(i) Find the distance of first position of the pigeon from the eyes of the boy.

(a) 54 m

(b) 100 m

(c) $\dfrac{100}{\sqrt{3}}$ m

(d) $100\sqrt{3}$

(ii) If the distance between the position of pigeon increases, then the angle of elevation

(a) Increases   (b) decreases   (c) remains unchanged   (d) can't say

(iii) Find the distance between the boy and the pole.
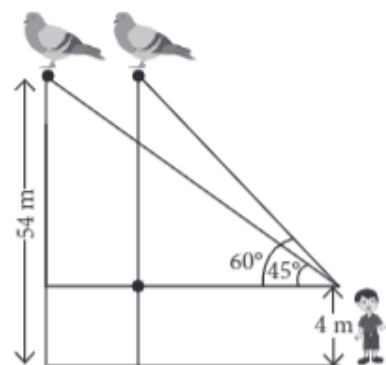
(a) 50 m

(b) $\dfrac{50}{\sqrt{3}}$ m

(c) $50\sqrt{3}$ m

(d) $60\sqrt{3}$ m

(iv) How much distance the pigeon covers in 8 seconds?

(a) 12.13 m   (b) 19.60 m   (c) 21.09 m   (d) 26.32 m

(v) Find the speed of the pigeon.

(a) 2.63 m/sec   (b) 3.88 m/sec   (c) 6.7 m/sec   (d) 9.3 m/sec

Wooden Stool

Aditi purchase a wooden bar stool for her living room with square top of side 2 m and having height of 6 m above the ground. Also each leg is inclined at an angle of 60° to the ground as shown in the figure (not drawn to scale).

Based on the above information, answer the following questions. (Take $\sqrt{3} = 1.73$)

(i) Find the length of the each leg.

(a) 5.9 m   (b) 6.93 m   (c) 7.3 m   (d) 8.2 m

(ii) Find the length of GH.

(a) 0.53 m   (b) 1 m   (c) 1.15 m   (d) 2.73 m

(iii) The length of second step is
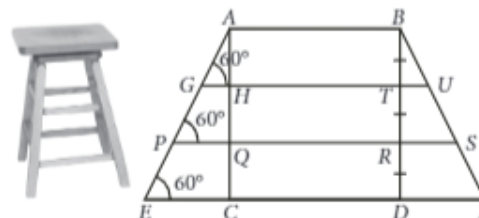
(a) 4.3 m   (b) 4.99 m   (c) 5.68 m   (d) 6.78 m

(iv) The length of PQ =

(a) 1.56 m   (b) 2.31 m   (c) 3.34 m   (d) 5.68 m

(v) The length of first step is

(a) 4.78 m   (b) 5.34 m   (c) 6.62 m   (d) 7.82 m

1. **(i) (c) :** Since, $AE \parallel FD$

$\therefore \quad \angle EAD = \angle ADF = 30°$

[Alternate interior angles]

(ii) (b): Since, $AE \parallel BC$

$\therefore \quad \angle EAC = \angle ACB = 60°$

[Alternate interior angles]

(iii) (a): In $\triangle ABC$,

$\tan 60° = \dfrac{AB}{BC} \Rightarrow \sqrt{3} = \dfrac{50}{BC}$

$\Rightarrow \quad BC = \dfrac{50}{\sqrt{3}} = 28.90$ m

(iv) (c): In $\triangle ADF$, $\tan 30° = \dfrac{AF}{FD}$

$\Rightarrow \quad \dfrac{1}{\sqrt{3}} = \dfrac{AB - BF}{FD} \Rightarrow \dfrac{1}{\sqrt{3}} = \dfrac{50 - CD}{\dfrac{50}{\sqrt{3}}}$

$$\left[\because FD = BC = \dfrac{50}{\sqrt{3}} \right]$$

$\Rightarrow \quad \dfrac{50}{3} = 50 - CD \Rightarrow CD = 50 - \dfrac{50}{3} = \dfrac{100}{3} = 33.33$ m

(v) (d)

2. **(i) (b):** The person who makes small angle of elevation is more closer to the balloon.

$\therefore$ Radha is more closer to the balloon.

(ii) (b): In $\triangle EFD$, $\tan 30° = \dfrac{ED}{DF}$

$\Rightarrow \quad \dfrac{1}{\sqrt{3}} = \dfrac{h}{DF}$

$\Rightarrow \quad DF = h\sqrt{3}$ m

(iii) (a): In $\triangle GCE$,

$\tan 60° = \dfrac{EC}{GC} = \dfrac{h+4}{DF}$

$\Rightarrow \quad \sqrt{3} = \dfrac{h+4}{\sqrt{3}h} \Rightarrow 3h = h + 4 \Rightarrow h = 2$

(iv) (c): Height of the balloon from the ground = BE

$= BC + CD + DE = 2 + 4 + 2 = 8$ m

(v) (b)

3. **(i) (d):** Let h be the height of the pole.

In $\triangle ABC$,

$\dfrac{h}{15} = \sin 45° \Rightarrow \dfrac{h}{15} = \dfrac{1}{\sqrt{2}}$

$\Rightarrow \quad h = \dfrac{15}{\sqrt{2}}$ m

(ii) (a): Let x be the required distance.

In $\triangle ABC$,

$\dfrac{x}{15} = \cos 45° = \dfrac{1}{\sqrt{2}}$

$\Rightarrow \quad x = \dfrac{15}{\sqrt{2}}$ m

(iii) (c): Let h be the height of the pole.

In right triangle ABC,

$\dfrac{h}{15} = \sin 30° = \dfrac{1}{2}$

$\Rightarrow \quad h = \dfrac{15}{2} = 7.5$ m

(iv) (d): If 3 m rope is broken, then the length of the rope is 12 m.

In $\triangle ABC$, $\dfrac{h}{12} = \sin 30° = \dfrac{1}{2}$

$\Rightarrow \quad h = \dfrac{12}{2} = 6$ m

(v) (c)

4. **(i) (c):** Let AC be the length of the ladder.

In $\triangle ABC$, $\dfrac{BC}{AC} = \sin 30°$

$\Rightarrow \quad \dfrac{6}{AC} = \dfrac{1}{2} \Rightarrow AC = 12$ m

(ii) (b): In $\triangle ABC$, $\dfrac{AB}{AC} = \cos 30°$
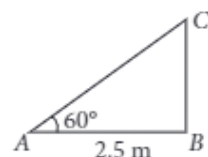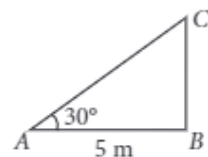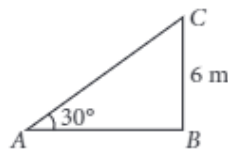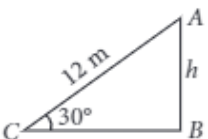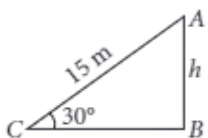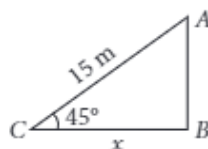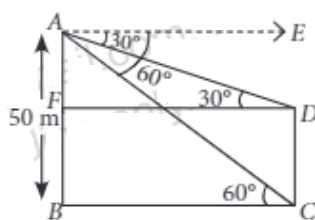
$\Rightarrow \quad \dfrac{5}{AC} = \dfrac{\sqrt{3}}{2} \Rightarrow AC = \dfrac{10}{\sqrt{3}}$ m

(iii) (a): Let BC be the height of window from ground.

In $\triangle ABC$, $\dfrac{BC}{AB} = \tan 60°$

$\Rightarrow \quad \dfrac{BC}{2.5} = \sqrt{3}$
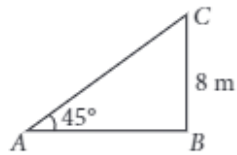
$\Rightarrow \quad BC = 2.5 \times 1.73 = 4.325$ m

(iv) (d): Let AB be the horizontal distance between the foot of ladder and wall.

In $\triangle ABC$, $\dfrac{BC}{AB} = \tan 45°$

$\Rightarrow \dfrac{8}{AB} = 1 \Rightarrow AB = 8\,\text{m}$
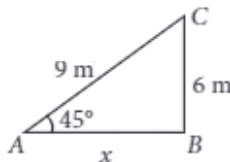
**(v) (b):** Let the required distance be x.

In $\triangle ABC$, $(9)^2 = x^2 + (6)^2$

[By Pythagoras theorem]

$\Rightarrow 81 - 36 = x^2 \Rightarrow 45 = x^2$

$\Rightarrow x = 3\sqrt{5}\,\text{m}$

5. (i) (b): Total height of pole = 8 m

$\therefore BD = AD - AB = (8-2)\text{m} = 6\,\text{m}$

(ii) (a): In $\triangle BDC$, $\dfrac{BD}{BC} = \sin 60°$

$\Rightarrow \dfrac{6}{BC} = \dfrac{\sqrt{3}}{2}$

$\Rightarrow BC = \dfrac{12}{\sqrt{3}} \times \dfrac{\sqrt{3}}{\sqrt{3}} = 4\sqrt{3}\,\text{m}$

(iii) (d): In $\triangle BDC$,

$\dfrac{BD}{CD} = \tan 60° \Rightarrow \dfrac{6}{CD} = \sqrt{3} \Rightarrow CD = \dfrac{6}{\sqrt{3}} \times \dfrac{\sqrt{3}}{\sqrt{3}} = 2\sqrt{3}\,\text{m}$

(iv) (b): If $\triangle BCD$,

$\dfrac{BD}{CD} = \tan \theta \Rightarrow 1 = \tan \theta$ $[\because BD = CD]$

$\Rightarrow \theta = 45°$

(v) (c): In $\triangle BDC$, $\angle B + \angle D + \angle C = 180°$

$\therefore \angle B = 180° - 60° - 90° = 30°$

6. (i) (c): In $\triangle ABC$, $\dfrac{AB}{BC} = \tan 60°$

$\Rightarrow AB = 25 \times \sqrt{3}$

$\therefore$ Height of building is $25\sqrt{3}\,\text{m}$.

(ii) (b): In $\triangle ABD$, $\dfrac{AB}{BD} = \tan 30°$

$\Rightarrow \dfrac{25\sqrt{3}}{BD} = \dfrac{1}{\sqrt{3}} \Rightarrow BD = 75\,\text{m}$

$\therefore$ Distance between two positions of car = $(75 - 25)$ m = 50 m.

(iii) (d): Time taken to cover 50 m distance = 6 sec.

$\therefore$ Time taken to cover 25 m distance = 3 sec.

$\therefore$ Total time taken by car = 6 sec + 3 sec = 9 sec

(iv) (c): In $\triangle ABC$, $\dfrac{BC}{AC} = \cos 60°$

$\Rightarrow \dfrac{25}{AC} = \dfrac{1}{2}$

$\Rightarrow AC = 50\,\text{m}$

(v) (a)

7. (i) (b): $\angle XAC = 45°$ (Given)

$\therefore \angle ACD = 45°$ [Alternate interior angles]

(ii) (b)

(iii) (c): In $\triangle ACD$,

$\dfrac{AD}{DC} = \tan 45°$

$\Rightarrow \dfrac{100}{DC} = 1 \Rightarrow DC = 100\,\text{m}$

(iv) (d): In $\triangle ABD$, $\dfrac{AD}{BD} = \tan 30°$

$\Rightarrow \dfrac{100}{BD} = \dfrac{1}{\sqrt{3}}$

$\Rightarrow BD = 100\sqrt{3}\,\text{m}$
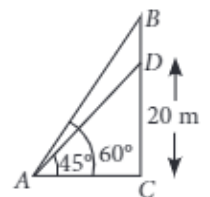
(v) (a): In $\triangle ADC$,

$\dfrac{AD}{AC} = \sin 45° \Rightarrow \dfrac{100}{AC} = \dfrac{1}{\sqrt{2}} \Rightarrow AC = 100\sqrt{2}\,\text{m}$

8. (i) (a): In $\triangle ACD$,

$\tan 45° = \dfrac{CD}{AC} = 1$

$\therefore AC = CD = 20\,\text{m}$ ...(i)

(ii) (b): Let, $BD = h$ m be the height of the statue.

In $\triangle ABC$, $\tan 60° = \dfrac{BC}{AC} \Rightarrow \dfrac{BD + CD}{AC} = \sqrt{3}$

$\Rightarrow \dfrac{20 + h}{20} = \sqrt{3}$ [using (i)] $\Rightarrow h = 20(\sqrt{3} - 1)\,\text{m}$.
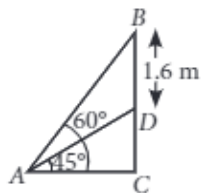
(iii) (d): Since, in $\triangle ACD$, $\angle DAC = 45°$

$\therefore AC = CD$ (say x)

In $\triangle BAC$, $\tan 60° = \dfrac{BC}{AC}$

$\Rightarrow \dfrac{1.6 + x}{x} = \sqrt{3}$

$\Rightarrow 1.6 = x(\sqrt{3} - 1)$

$\Rightarrow$ $x = \dfrac{1.6}{\sqrt{3}-1} \times \dfrac{\sqrt{3}+1}{\sqrt{3}+1} = 0.8\,(\sqrt{3}+1)$ m

(iv) (c): In $\triangle ABC$,

$\tan 60° = \dfrac{BC}{AC} \Rightarrow \dfrac{39}{AC} = \sqrt{3}$

$\Rightarrow AC = \dfrac{39}{\sqrt{3}} \times \dfrac{\sqrt{3}}{\sqrt{3}} = 13\sqrt{3}$ m

(v) (a): In $\triangle ACD$, $\sin 45° = \dfrac{CD}{AD}$

$\Rightarrow \dfrac{35}{AD} = \dfrac{1}{\sqrt{2}}$

$\Rightarrow AD = 35\sqrt{2}$ m

9. (i) (c)

(ii) (a): Let AB be the height of pedestal.

In $\triangle ABC$,

$\tan 30° = \dfrac{AB}{BC}$

$\Rightarrow AB = \dfrac{25}{\sqrt{3}} = \dfrac{25}{1.73} = 14.45$ m

(iii) (d): Let x be the distance between Arun and Pankaj.

In $\triangle ABD$, $\tan 45° = \dfrac{AB}{BD}$

$\Rightarrow BD = 30$ m

Now, in $\triangle ABC$,

$\tan 30° = \dfrac{AB}{BC}$
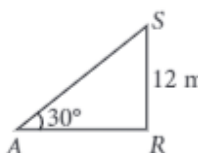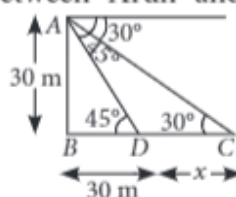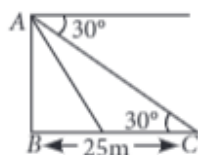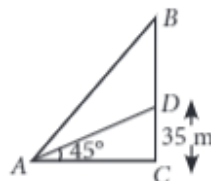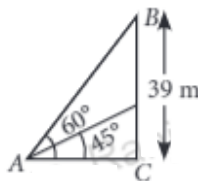
$\Rightarrow \dfrac{30}{30+x} = \dfrac{1}{\sqrt{3}}$

$\Rightarrow x = 30\,(\sqrt{3}-1) = 30 \times 0.73 = 21.9$ m

(iv) (c): In $\triangle ARS$,

$\sin 30° = \dfrac{RS}{AS}$

$\Rightarrow \dfrac{12}{AS} = \dfrac{1}{2} \Rightarrow AS = 12 \times 2 = 24$ m

(v) (c): In $\triangle ABD$, $\dfrac{AB}{BD} = \tan 60°$

$\Rightarrow \dfrac{AB}{15} = \sqrt{3}$

$\Rightarrow AB = 15 \times 1.73 = 25.95$ m

10. (i) (c): In $\triangle OPQ$, we have

$\tan 60° = \dfrac{PQ}{PO}$

$\Rightarrow \sqrt{3} = \dfrac{20}{PO}$

$\Rightarrow PO = \dfrac{20}{\sqrt{3}}$ m

(ii) (b): In $\triangle ORS$, we have

$\tan 30° = \dfrac{RS}{OR} \Rightarrow \dfrac{1}{\sqrt{3}} = \dfrac{20}{OR} \Rightarrow OR = 20\sqrt{3}$ m

(iii) (d): Clearly, width of the road $= PR$

$= PO + OR = \left(\dfrac{20}{\sqrt{3}} + 20\sqrt{3}\right)$m

$= 20\left(\dfrac{4}{\sqrt{3}}\right)m= \dfrac{80}{\sqrt{3}}$ m $= 46.24$ m

(iv) (a): In $\triangle OPQ$, if $\angle POQ = 45°$, then

$\tan 45° = \dfrac{PQ}{PO} \Rightarrow 1 = \dfrac{20}{PO} \Rightarrow PO = 20$ m

(v) (b)

**11. (i) (c):** Let AB be the tree of height h m and let it broken at height of x m, as shown in figure.
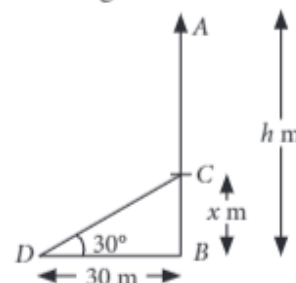
Clearly $CD = AC = (h-x)$ m

Now, in $\triangle CBD$, we have

$\tan 30° = \dfrac{x}{30}$

$\Rightarrow x = \dfrac{30}{\sqrt{3}}$ m

Thus, the height of remaining part of the tree is $\dfrac{30}{\sqrt{3}}$ m.
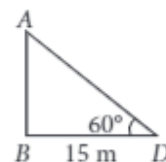
(ii) (c): In this case, $BD = BC = x$ m

$\therefore$ If θ be the angle of inclination, then

$\tan\theta = \dfrac{BC}{BD} = 1$

$\Rightarrow \tan\theta = \tan 45°$

$\Rightarrow \theta = 45°$

(iii) (b): The angle of elevation and depression are always acute angles.

(iv) (d): Clearly, $BD = AB - AD$

$= \left(10\sqrt{3} - 2\sqrt{3}\right)m = 8\sqrt{3}\,m$

Now, in ΔBCD, we have

$\sin 60° = \dfrac{BD}{DC}$

$\Rightarrow \dfrac{\sqrt{3}}{2} = \dfrac{8\sqrt{3}}{DC} \Rightarrow DC = 16\,m$

(v) (a): Here, $h = 6\,m$, $\theta = 30°$

$\therefore DC = AC = (6-x)\,m$

Now, in ΔBCD, we have

$\sin 30° = \dfrac{BC}{CD}$

$\Rightarrow \dfrac{1}{2} = \dfrac{x}{6-x}$

$\Rightarrow 6 - x = 2x$

$\Rightarrow 3x = 6 \Rightarrow x = 2$

12. (i) (d): Clearly, $\angle DAC = 60°$

So, in ΔADC, we have

$\tan 60° = \dfrac{CD}{AD} \Rightarrow \sqrt{3} = \dfrac{6}{AD}$

$\Rightarrow AD = \dfrac{6}{\sqrt{3}}\,m$

(ii) (b): Clearly, $\angle DBC = 30°$

So, in ΔBDC, we have

$\tan 30° = \dfrac{CD}{BD}$

$\Rightarrow \dfrac{1}{\sqrt{3}} = \dfrac{6}{BD}$

$\Rightarrow BD = 6\sqrt{3}\,m$

(iii) (b): Width of the river $= AB = AD + BD$

$= \dfrac{6}{\sqrt{3}} + 6\sqrt{3}$

$= 6\left(\dfrac{1}{\sqrt{3}} + \sqrt{3}\right) = 6\left(\dfrac{4}{\sqrt{3}}\right) = \dfrac{24}{\sqrt{3}}\,m = 13.87\,m$

(iv) (a): The angle of elevation and angle of depression are always acute angles.

(v) (c): In ΔBCD, if $BD = 21\,m$, then

$\tan 30° = \dfrac{CD}{BD}$

$\Rightarrow \dfrac{1}{\sqrt{3}} = \dfrac{CD}{21} \Rightarrow CD = \dfrac{21\sqrt{3}}{3} = 7\sqrt{3}\,m$

13. (i) (b): In the right ΔADQ, we have

$\sin 30° = \dfrac{DQ}{AD} \Rightarrow \dfrac{1}{2} = \dfrac{DQ}{24}$

$\Rightarrow DQ = 12\,m$

Thus, distance of paraglider from the ground is 12 m.

(ii) (a): We have $PQ = BC = 6\,m$

Now, as $DQ = 12\,m$

$\therefore DP = DQ - PQ = 12 - 6 = 6\,m$

(iii) (c): In right ΔBDP, we have

$\sin 45° = \dfrac{DP}{BD} \Rightarrow \dfrac{1}{\sqrt{2}} = \dfrac{6}{BD}$
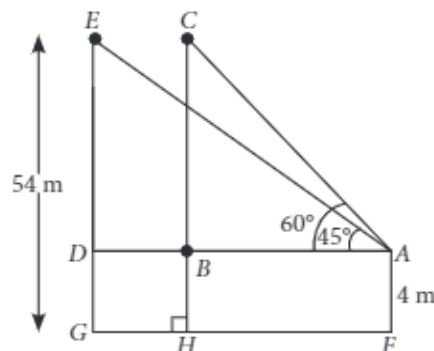
$\Rightarrow BD = 6\sqrt{2}\,m$

Thus, the distance of paraglider from the girl is $6\sqrt{2}\,m$.

(iv) (d): $\angle AOP$ given in figure, is the angle of depression.

(v) (c): If A and B are two objects and the eye of an observer is at point O, then line of sight will be both OA and OB.

14. (i) (c): Distance of first position of pigeon from the eyes of boy $= AC$

In ΔABC,

$\sin 60° = \dfrac{BC}{AC} \Rightarrow AC = \dfrac{CH - BH}{\sin 60°} = \dfrac{54 - 4}{\sqrt{3}/2} = \dfrac{100}{\sqrt{3}}\,m$

(ii) (b): If the distance increases, then the angle of elevation decreases.

(iii) (b): Distance between boy and pole $= AB$

Now, in $\triangle ABC$,

$\tan 60° = \dfrac{BC}{AB} \Rightarrow \sqrt{3}\, AB = 50 \Rightarrow AB = \dfrac{50}{\sqrt{3}}$ m

(iv) (c): In $\triangle AED$, $\tan 45° = \dfrac{ED}{AD}$

$\Rightarrow AD = BC = 50$ m $\qquad (\because ED = BC)$

Now, distance between two positions of pigeon $= EC$

$= BD = AD - AB$

$= \left(50 - \dfrac{50}{\sqrt{3}}\right)$ m $= \dfrac{50(1.73-1)}{1.73} = 21.09$ m

(v) (a): Speed of pigeon $= \dfrac{\text{Distance covered}}{\text{Time taken}}$

$= \left(\dfrac{21.09}{8}\right)$ m/sec $= 2.63$ m/sec

15. Given, side of square top $= 2$ m

$\therefore AB = HT = QR = CD = 2$ m

Also, AC and BD are perpendicular to the ground.
So, $AH = HQ = QC$. (By B.P.T. Theorem)

(i) (b): In $\triangle AEC$,

$\sin 60° = \dfrac{AC}{AE} \Rightarrow \dfrac{\sqrt{3}}{2} = \dfrac{6}{AE} \Rightarrow AE = 6.93$ m

$\therefore$ Length of each leg $i.e.,$ $AE = BF = 6.93$ m.

(ii) (c): In $\triangle AGH$, $\tan 60° = \dfrac{AH}{GH} \Rightarrow \sqrt{3} = \dfrac{2}{GH}$

$\Rightarrow GH = 1.15$ m

(iii) (a) : Length of second step $= GH + HT + TU$
$= 1.15 + 2 + 1.15 = 4.3$ m

(iv) (b): In $\triangle APQ$,

$\tan 60° = \dfrac{AQ}{PQ} \Rightarrow \sqrt{3} = \dfrac{4}{PQ} \Rightarrow PQ = \dfrac{4}{\sqrt{3}}$ m $= 2.31$ m

(v) (c): Length of first step $= PQ + QR + RS$
$= 2.31 + 2 + 2.31 = 6.62$ m